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The bold debunker whose split-brain research galvanized neurophysiology now plans to topple the last great pillar of conventional science

INTERVIEW

ROGER SPERRY

New York editor made a number of changes in the introduction and omissions in the interview which we were not given a chance to correct.

Science was wrong Its interpretations of man and the world were demeaning and dehumanizing," declares pioneering brain researcher Roger Sperry. "All physical reality, including the human psyche, was reduced to quantum mechanics. The richness, color, and beauty were all lost in mathematical concepts." At sixty-nine, the man who shared the 1981 Nobel Prize in medicine and physiology for his famous split-brain studies has turned his attention to battling the materialist legacy of twentieth-century science. This latest assault on orthodoxy comes as no surprise, because Sperry, though shy and reserved by nature, has never been afraid to challenge accepted doctrine. In his 40-year quest to understand the nature of human consciousness, he has overturned more than one cherished belief. Bearded, with bullet eyes capped by gracefully arched brows, Sperry may have been destined to play the part of scientific debunker. As one former colleague notes, Sperry is "constitutionally able to be interested only in critical issues."

Even as a graduate student at Oberlin College, in Oberlin, Ohio, Sperry challenged his distinguished mentor Paul Weiss, who propounded the view that neural connections were determined by experience rather than genetic mechanisms. To test his theory, the young scientist designed an intriguing experiment that involved rotating the eyes of a salamander by 180 degrees. If Weiss's theory that "function precedes form" were correct, the salamander would eventually adjust to seeing the world upside down and alter its behavior accordingly. But the poor salamander never learned to compensate for its distorted vision. Even after hundreds of training trials, it continued to dart in the opposite direction of any lure placed in its tank. Moreover, when Sperry severed the nerve pathways to the eye, the tangled fibers somehow sorted

PHOTOGRAPH BY CHRISTOPHER SPRINGMANN

themselves out, only to reestablish the same "upside-down" connections as before. Neural networks, Sperry concluded, organize themselves independently of the function they ultimately come to perform. Even today, his landmark study is touted by those who believe that basic behavioral patterns of humans and other organisms are heavily influenced by genetic factors.

The way that growing nerve fibers are guided to predetermined connections preoccupied Sperry for the next decade, eventually leading him to postulate that brain cells use "a kind of probing chemical-touch system." His theory—that the nervous system arranges itself according to a chemical code roughly analogous to the color code that governs the wiring of circuits in a telephone receiver—is now considered a keystone of developmental neurobiology. But in the intellectual climate of the early Forties, Sperry's concept of a "hard-wired" brain met strong resistance.

One major opponent of this viewpoint was the eminent neurophysiologist Karl Lashley, whom Sperry worked under at the Yerkes Laboratories of Primate Biology, then located in Florida. Lashley's arguments against the specificity of nerve connections stemmed in part from reports about a rare group of patients who had undergone radical brain surgery to stop intractable epilepsy. These people were operated on to sever the corpus callosum, the main nerve cable that connects the cerebral hemispheres.

"At that time the corpus callosum was an enigma," recalls Sperry. "You could cut it completely—two hundred million nerve fibers—and it didn't seem to cause any functional deficit that people noticed. This fit in with a commonly held notion that the brain is characterized by wholesale plasticity and comes out functioning fine no matter how you cut or scramble its nerves."

A decade of animal studies soon dispelled many false ideas about the corpus callosum, including Lashley's assertion that it was little more than a mechanical prop to stop the hemispheres from sagging. Once this connection was broken, it was as if two minds resided in the one brain. Each half of the cerebrum was capable of learning, remembering, and feeling thoughts completely unknown to the other. To Sperry, the conclusion was inescapable: The neural isthmus must be vital for an integrated sense of awareness.

Still greater revelations followed. In 1953 Sperry was appointed Hixon Professor of Psychobiology, at the California Institute of Technology, a post he has held for the last 30 years. Shortly thereafter he launched a series of now-classic studies of split-brain individuals—patients whose corpora callosa had been severed surgically. At first the test results appeared to support the popular contention that the right hemisphere was "mentally retarded" in comparison to the left hemisphere, which had long been recognized as the seat of linguistic abilities. Careful examination, however, altered the picture drastically. For example, a split-brain individual might categorically deny the existence of an object placed out of view in his left hand (sensory information is transmitted from the left hand to the right half of the brain). But if that same subject is given a nonverbal mode of identifying the object, such as feeling with his left hand for its match in a collection of items, he will invariably make the correct choice despite frequent protestations that he is merely guessing.

Clearly the right brain was neither dumb nor devoid of consciousness, as early authorities had insisted. It just lacked the words to inform investigators of its hidden talents. As Sperry disciple Michael Gazzaniga recalls, "No one was prepared for the riveting experience of observing a split-brain patient generating integrated activities with the mute right hemisphere that the language-dominant left hemisphere was unable to describe or comprehend."

Interestingly, the left hemisphere often proved all too willing to comment on matters it knew nothing about. During one routine test of a female patient's ability to make visual discriminations, Sperry replaced a slide of a household object with one showing a nude woman. Using a special apparatus, called a tachistoscope, he was able to project the picture only to her right hemisphere. The arresting stimulus triggered a sudden change of expression, and her face reddened as she laughed nervously. "What's so funny?" Sperry asked. Forced to rationalize an embarrassed response to something it had not seen, her left hemisphere replied, "I don't know . . . nothing . . . oh, that funny machine!"

"As evolution progresses, combining the atomic building blocks into ever-newer, more complex compounds, new properties emerge. In the brain, too, you have these nested hierarchies."

From this experiment and hundreds more like it, Sperry and his colleagues gained powerful insights into the dual nature of human consciousness. Today it is widely recognized that the left hemisphere is primarily verbal, logical, and sequential. The right side is viewed as more intuitive and emotional, specializing in visual-spatial problem solving and other situations in which a single impression or mental image is worth a thousand words.

For the most part, Sperry is glad that this distinction has entered the mainstream of public knowledge. In his Nobel lecture, he noted that split-brain studies have led to a better appreciation of nonverbal forms of intelligence and increased understanding of "the inherent individuality in the structure of human intellect." He also feels his research has helped to underscore the need for educational tests and policies "to selectively identify, accommodate, and serve the differentially specialized forms of individual intellectual potentials."

Still he can't help being amused by the cult following that the theory attracted in the Seventies, especially among philosophers, psychologists, and pedagogues. Sperry realizes that it's easy to become intoxicated by the implications of the bicameral mind. He treated the subject with characteristic dry wit when he accepted the 1979 Ralph Gerard Prize of the Society for Neuroscience: "The great pleasure and feeling in my right brain is more than my left brain can find the words to tell you."

The achievements of Sperry's left brain earned him numerous other awards and honors before the Nobel Prize, including the 1979 Albert Lasker Award, the highest distinction in American medicine. But as a sculptor and self-described dabbler in artistic pursuits, including folk dancing, ceramics, and figure drawing, he hasn't neglected development of his right brain, either. As a child growing up in rural Connecticut, he also acquired a passion for wildlife that has persisted to this day. Outdoor activities—camping, fishing, fossil hunting—now dominate what leisure time he can find in his busy schedule.

An intensely private man who prefers the solace of nature to life in the limelight, Sperry conveniently vanished from sight at the time of the Nobel announcement. While his Pasadena office struggled to handle the deluge of calls and telegrams that poured in from well-wishers all over the world, he and his wife snorkeled along the beaches of Baja California, returning only after the hoopla had subsided.

When not retreating to the wilderness, Sperry spends most of his quiet moments exploring the broader ramifications of his revised view of consciousness, applying his knowledge of individual awareness to global phenomena. He is, in effect, superimposing the bicameral mind on the collective consciousness of society, attempting to reconcile two schools of thought: the reductionist view of the scientific materialist, who adopts the left brain's strategy of chopping up reality into fragments; and the humanistic view of the philosopher, who favors the right brain's holistic perspective, which incorporates emotions, ethics, and other complex values.

Just as the left hemisphere was once thought to dominate human consciousness, Sperry feels that its cultural counterpart—reductionism—has been given too much weight in society. Still the zealous debunker of his youth, he is quietly chipping away at this last great pillar of modern

science. And when it finally topples, he intends to lay the foundations for a much more integrated world view of science—one that encompasses the concerns of the humanist and the reductionist under one intellectual umbrella. In his recently published book, *Science and Moral Priority*, Sperry explains how these revisions could qualify science for a higher role in society as a partner with religion in the quest for an ultimate ethical and moral frame of reference. Changes in our social priorities, he believes, are a prime requisite for civilization's survival.

Sperry talked about his views with science writer Yvonne Baskin in his office in Caltech's Norman Church Laboratory.

Omni: Aren't ethics and moral values pretty far afield for a brain scientist?

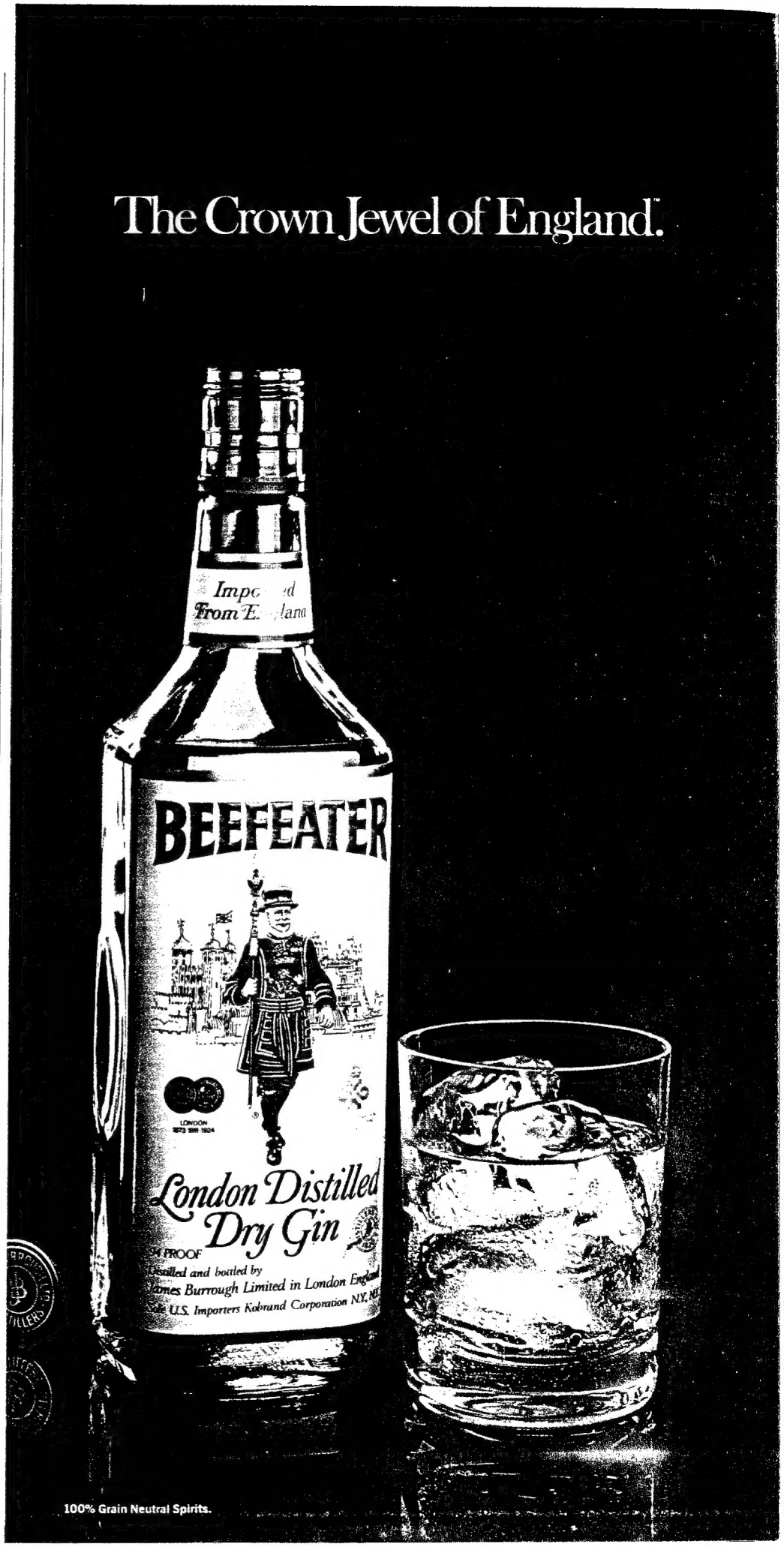
Sperry: In some ways, but actually they're a natural follow-up to something I came upon in the mid-Sixties—a modified concept of the mind-brain relation. It's common practice in science to follow up on the most promising leads opened by any new discovery, and these human-value implications seemed to be far and away the most important.

Omni: Granted, human values are important, but don't they take you way outside the bounds of science?

Sperry: Well, my scientific colleagues sometimes think that I've gone off the deep end or something, but I don't look at it that way. I view it more as a shift to a new scientific area that's now developing. You see, according to our new views of consciousness, ethical and moral values become a very legitimate part of brain science. They're no longer conceived to be reducible to brain physiology. Instead, we now see that subjective values themselves exert powerful causal influence in brain function and behavior. They're universal determinants in all human decision making, and they're actually the most powerful causal control forces now shaping world events. No other causal system with which science now concerns itself—earthquakes, chemical reactions, magnetic fields, you name it—is of more critical importance in determining our future.

Omni: Your research defined with new clarity the different but complementary roles of the right and left sides of the brain. A lot of follow-up work remains to be done on the way the two hemispheres interact and how the dominance of the right or left hemisphere of the brain in an individual correlates with sex, musical or mathematical ability, creativity, occupational preferences, right- or left-handedness, and so on. Doesn't this work interest you anymore?

Sperry: Yes, of course, it's all interesting and important science. But you always have to ask, "What difference does it make?" Or better, "What difference is it going to make ten years from now?" You look around at all the looming threats of global disaster and the declining quality of life, and wonder, "What difference will it make if we suc-



ceed in improving educational policies a little, or neurologic diagnoses, or our understanding of right-left differences, or details of hemispheric interaction?"

Then, by contrast, think what even a very slight shift of values would do in the delicate balance of opposing positions in the abortion controversy, for example, or in various environmental matters, or other global issues. We're talking here about hundreds of thousands of lives, pro or con, about the kind of world we and our grandchildren will live in—if they live at all—and the kind of laws we're governed by. When you see your science having direct and compelling implications in these areas, it's hard to turn away and go back to more laboratory experiments, especially when you see in this new path the one humane means for getting us out of our current global straits.

Omni: But doesn't science in its traditional role provide hope for concrete technical solutions to many of today's problems?

Sperry: Technological answers by themselves, in the absence of population controls, just put us deeper and deeper in a self-feeding, vicious spiral of mounting population, pollution, energy and resource demands, and so on.

Omni: The best way to break this spiral is to change man's sense of values—to evolve a new global ethic or theology?

Sperry: That's the most humane way. A nuclear holocaust, global famine, or some other worldwide catastrophe would do it, of course; so would just letting things continue as they are. But the most painless and reasonable solution presently visible is to change the kinds of values and beliefs we live and govern by. Others agree with this. Lester Brown, of the Worldwatch Institute, comes to the same conclusion in his latest book, *Building a Sustainable Society*. The National Council of Churches sponsored a meeting three years ago at which representatives from different faiths affirmed that what the world needs today is a new religion, a new theology that will promote the values of conservation, renewable energy, and respect for the land.

Think what would happen if the values of conservation, population control, and so on were to be lifted above the level of just wisdom and expediency to become matters of deep religious conviction. Imagine if people worldwide believed it to be immoral, even sacrilegious, to pollute, overpopulate, or in any other way degrade the quality of the biosphere for future generations. This is where our changed views of brain and consciousness seem to lead.

Omni: But proposing new values is quite different from just scientifically studying already existent values.

Sperry: True, but the two are not separate. The increased understanding of the origins of our value systems enables us to choose our moral positions more wisely.

But this is only part of it. The main point is that our recently changed views in mind-brain science radically alter traditional beliefs about the nature of man and the world, about the relation of mind to matter, of science to values, about free will and moral responsibility. Even beliefs about science are changed, its scope and limitations, its world view, concepts of causation, and the relation of science to the humanities. Everything's transformed. We come out with a whole new outlook, new beliefs about all that we group together as reality.

Omni: Aren't people worried at the thought of changing human values through science and technology?

Sperry: It's not a matter of altering values directly or experimentally. It's more a matter of bringing scientific knowledge to bear where values are already in conflict. We're still in the early phase of this. It wasn't too many years ago that values were generally considered to be off limits to science.

Omni: Let's start at the beginning. What was this change in the concepts of consciousness and mind-brain relation that first prompted you to endorse the merging of science and ethical and social values?

Since each side of the surgically divided brain is able to sustain its own conscious volitional system, the question arises, Why don't we perceive of ourselves as two persons?

Sperry: It was the change involved in the so-called consciousness, or mentalist, revolution in psychology that took place during the Seventies, a turnabout in the treatment of consciousness. Behaviorist principles, which had dominated for over half a century, were overturned. Psychology suddenly began to treat subjective events—mental images, inner thoughts, sensations, feelings, ideas, and so on—as factors having a genuine causal role in brain function and behavior. The contents of introspection, the whole world of inner experience, suddenly became accepted as elements that could influence physical and chemical events in the brain, they were no longer treated as passive, noncausal aspects or even as nonexistent ones.

Omni: What you're saying is that neuroscientists previously found it difficult to see how the sequence of brain events could ever be influenced by anything other than strictly material, physical, and chemical agents. Scientists believed that any step in the process must have physical cause.

Sperry: Exactly. That was the view accepted by psychologists as well, and the farther neuroscience advanced, the more convincing their arguments seemed. It appeared that a complete account of brain function and, for that matter, all of nature could be given in purely material physicochemical terms without any need to refer to conscious, mental, or vital forces of any kind. Science claimed it had absolutely no use for consciousness since consciousness couldn't do anything in the brain and didn't change anything. There was no need for it in a causal explanation. The progress of brain science toward an ultimate physicochemical description of behavior seemed to leave less and less for anything like human dignity, moral choice, meaning, purpose, and such things that go hand in hand with human values. That's what I meant when I said science was demeaning and dehumanizing.

Omni: What happened to cause the shift in psychology away from these established behaviorist views?

Sperry: In part, the time was right. Many things came together that collectively outweighed the old arguments in favor of the new. Earlier views had been floating around that came close to the current revised concepts: gestalt and humanistic views in psychology, concepts of phenomenology, systems theory, tacit knowing, emergence, holism, and so on. The question is, What happened to change all of this from the status of occasional scattered philosophy and minority science to its present status as the dominant doctrine?

I think it was largely a matter of demonstrating a logical flaw in our seemingly airtight reasoning, finding a new, different logic that fit more widely and combined earlier threads into a new formula for mind-brain interaction. Mostly, perhaps, it was the introduction of some new ideas about causation applied to the chain of command in brain dynamics. When you talk about causes and causal control, science invariably listens!

The key realization was that the higher levels in brain activity control the lower. The higher cerebral properties of mind and consciousness are in command. They envelop, carry, and overwhelm the physicochemical details. They call the plays, exerting downward control over the march of nerve-impulse traffic. Our new model, mentalism, puts the mind and mental properties to work and gives them a reason for being and for having evolved in a physical system. It also shows how it's possible for mind to be created out of matter in fetal growth.

Omni: How do you define mentalism?

Sperry: Mentalism is contrasted in psychology to behaviorism and materialism. It's a doctrine holding that mental events, as consciously experienced in the mind, determine and explain behavior. The mental qualities used to be conceived in nonphysical, supernatural terms, but we now view them as the emergent properties of brain processes.

Omni: What are emergent properties?

Sperry: *Emergent* is the same as *holistic*, the Greek word for "whole." The properties of the whole are contrasted to those of its parts; the concept encompasses the old maxim that "the whole is greater than, and different from, the sum of the parts." As evolution progresses, combining the atomic building blocks into ever-newer and more complex compounds and then compounding the compounds, new properties emerge at each step. So you start with the subatomic physical properties and work upward through chemistry, biology, psychology, sociology. In the brain, too, you have these nested hierarchies from subatomic levels upward, with emergent properties at each level and conscious properties at the top.

***Omni*:** How does your shift to this mentalist view fit in with the split-brain studies?

Sperry: It was a matter of explaining the effects of split-brain surgery on conscious experience. We found that each disconnected hemisphere was capable of sustaining its own conscious awareness, each largely oblivious of experiences of the other. The separated hemispheres were able to carry on independently at a fairly high level. They could even perform mutually contradictory tasks at the same time, and each was able to exert its own volitional control and select its own differential preferences.

For example, in a blindfold test for tactual sorting, both hands might search together through a scrambled pile of different-shaped beads. One hand would sort out spheres into an upper tray and cylinders into a lower, while the other hand would do just the reverse. In the process each hemisphere would consciously and voluntarily make decisions opposite to those going on in the partner hemisphere. And neither disconnected hemisphere would seem to know what the other was doing. The vocal left hemisphere could report that it had no clue about the experience in the right hemisphere. Left and right domains of conscious awareness and volition seem to be almost as separate as if they were in two different heads.

Since each side of the surgically divided brain is able to sustain its own conscious volitional system in this manner, the question arises, Why, in the normal state, don't we perceive of ourselves as a pair of separate left and right persons instead of the single, apparently unified mind and self that we all feel we are?

***Omni*:** And the answer required a changed view of consciousness?

Sperry: Not directly. I had earlier proposed that conscious meaning emerges because brain processes adjust to interact with perceived objects rather than copy them. For example, when we look at a house, the brain doesn't so much copy the house as it prepares for a functionally adaptive response with respect to the house—the approach, location, form, memories, associations, and so on.

In wrestling with the split-brain problem, I realized that this kind of interaction with, and response to, objects and other inputs requires that emergent consciousness have a causal impact on brain activity. The normal bilateral consciousness can be viewed as a higher emergent entity that's more than just the sum of its right and left awareness and supersedes this as a directive force in our thoughts and actions.

***Omni*:** So the two hemispheres normally function together as an integrated whole, and the mind as a bilateral unit then arbitrates and integrates the activities within each hemisphere, making decisions that are carried out as physical or chemical events in either or both sides?

Sperry: That's the idea, yes. Putting all this together with some notions about emergence and causation, I found I could see a way around the old behaviorist logic and the mind-brain paradox, a way to finally affirm the causal usefulness of consciousness without violating scientific principles.

***Omni*:** The mind-brain paradox?

Sperry: The puzzling contradiction traditionally posed by subjective versus objective views. On one hand, introspection gives the impression that consciousness is very important in determining our thinking and what we do. On the other hand, objective science tells us that consciousness has absolutely no role in controlling brain activity or human behavior. Each view seems strong in its own right and irreconcilable with the other.

"Consciousness, free will, and values: three long-standing thorns in the hide of science. They are in direct conflict with the basic models. Science has had to deny their existence."

***Omni*:** What about free will, the idea that we seem to have the power to do whatever we choose at any instant, regardless of any laws of brain function?

Sperry: This is opposed, of course, to the old reductionist scientific view that we are causally controlled and have to do everything exactly as we do it—that we could not have behaved other than we did at any time. This was one of the so-called Big Three, another of the great unresolved paradoxes of science.

***Omni*:** What are the Big Three?

Sperry: Consciousness, free will, and values: three long-standing thorns in the hide of science. Materialist science couldn't cope with any of them, even in principle. It's not just that they're difficult. They're in direct conflict with the basic models. Science has had to renounce them—to deny their existence or to say that they're beyond the domain of science.

For most of us, of course, all three are among the most important things in life. When science proceeds to deny their importance, even their existence, or to say that they're beyond its domain, one has to wonder about science.

***Omni*:** Did science deny free will and call it just an illusion?

Sperry: In principle, brain science always assumed it could show just what physical and chemical events in the brain led you to make every single decision you made. Psychiatry and all the behavioral sciences are based on this principle, that all our behaviors, even the slightest mannerisms and nervous twitches, are caused, and if one probes deeply enough into the past, into the subconscious, or into brain physiology, one can find the causes and thereby explain and predict behavior.

***Omni*:** Do you think there is any real proof of this determinism?

Sperry: Proof seemed evident in experiments with posthypnotic suggestion in which a person would think he'd done something special of his own free will, but witnesses knew he or she had been instructed to do it under hypnosis and then told to forget having been hypnotized.

***Omni*:** But you believe our actions can be considered free despite this kind of causal control. How can you say this?

Sperry: We have to recognize different degrees of freedom and also different types and levels of causation, including higher kinds of causal control involving mental and vital forces that materialist science has always rejected. Remember that the revised mind-brain model makes conscious mental events causal. It follows that the causal antecedents of any consciously willed act are not just physiological but also mental. It's no longer a matter of the laws governing nerve-impulse traffic or inexorable physicochemical mechanisms. We deal instead with a sequence of conscious or subconscious processes that have their own higher laws and dynamics.

The higher-order mental processes move their neuronal details in much the way a rolling wheel carries along its molecules, or the way different program images on a TV receiver determine the pattern of electron flow on the screen. Only, unlike a TV, not only does the brain "receive" or "play," but it generates, creating its own mental internal programs.

***Omni*:** Are you reversing the usual scientific interpretation, saying neural events don't determine mental events?

Sperry: Not at all. It's always a reciprocal relation, with mutual interaction. But because of the long history of reductionist bias in science, we need to actively emphasize the kind of causal control exerted by the higher over the lower.

***Omni*:** So our actions are still caused and directed, but the causes are mental in the

...m of percepts, insights, memories, ideas, ...easons, and logic?

Sperry: Yes, and also feelings, wants, needs, wishes, and values. We mustn't forget the right brain. Remember also that the mind can quickly scan not only the past but also the projected future consequences of a choice. Its dynamics transcend the time and space of brain physiology. When you put it all together on these revised terms, we come out doing what we please, what we decide we want to do. And this resolves the paradox.

Omni: But actions are still caused, not free?

Sperry: They're free to an extent. We're no longer subject to, or in the grip of, the laws of physics and chemistry, as inanimate objects are. Nor do we have to obey the laws of physiology, as do our autonomic and reflex responses, our hormones, and our heartbeat. In general we are free of the kind of mechanistic materialist forces with which science used to saddle us. We are lifted above these into a higher realm with a different kind of control—a control unequaled in freedom anywhere else in the known universe. If you think about it, you wouldn't really want total freedom from all causation. It would be chaos. We all want to retain some causal control of our own over what we do. We just don't want other things to be controlling us.

Omni: I've seen occasional statements that equate your views with animism or dualism. Is this a misinterpretation?

Sperry: Yes. I wholly reject anything supernatural, mystical, or occult in favor of the kind of reality validated by science—with the proviso, of course, that the kind of reality upheld by materialist science for more than a century has to be revised. Mentalism is strictly a one-world, this-world answer. I don't see any way for consciousness to emerge or be generated apart from a functioning brain. Everything indicates that the human mind and consciousness are inseparable attributes of an evolving, self-creating cerebral system.

Some people have used the new mentalist concepts to bolster mystical and supernatural beliefs, including those of parapsychology. Actually, under the new model, mental telepathy, psychokinesis, precognition, and the other so-called psi phenomena become even less likely than they were before.

Omni: In the past it has been a choice: the materialist descriptions of natural science on the one hand or various mystical or supernatural schemes of religion and philosophy on the other. If the new stance in science rejects both these traditional choices, where does it take us?

Sperry: Well, it's just a different, middle-of-the-road alternative, a changed scientific interpretation. Among other things, it includes mental and vital forces that science has traditionally renounced. Not only does it include mind, the historic antithesis of matter, but it also puts mind over matter in the hierarchy of causal controls. It offers a different right-brain picture of reality.

Omni: You say these principles are general, that they extend beyond mind-brain questions and apply to all the sciences?

Sperry: Yes. For example, in biology I've illustrated this recently in reference to the old, discarded notion of vitalism, the idea that life and living systems are characterized by special vital forces over and above those of physics and chemistry.

When the early biologists started hunting for these special living, or vital, properties, they of course failed to find anything. The longer, harder, and deeper they looked, the more convincing it appeared that there were no such things. So it was concluded that all living things are nothing but physicochemical processes in different forms and degrees of complexity. The idea of vitalism had already become a subject of scorn and derision among nearly all biologists by the Thirties and remains so to this day.

Omni: Would you revive vitalism?

Sperry: In a modified form, yes, although my colleagues shudder at this because of the mystic connotations of the word. A new word would be better, but in this case I'm not sure that we should revise the language just because a good word has mistakenly been given bad associations. We biologists had merely been searching in the wrong places. You don't look for vital forces among atoms and molecules. You look among living things—among cells and animals responding to one another, reproducing, breathing, eating, running, flying, swimming, building nests, and so on.

The special vital forces that distinguish living things from nonliving things are emergent, holistic properties, not properties of their physicochemical components. Nor can they be fully explained in mechanistic terms. This doesn't mean they're in any way supernatural or mystical. Those who conceived of vital forces in supernatural terms were just as wrong as those who denied the existence of such forces. In any living or nonliving thing, the spacing and timing of the material elements of which it is composed make all the difference in determining what a thing is.

Omni: Can you give an illustration?

Sperry: As a very simple example, take a population of molecules, say copper. You can shape this into a sphere, a pyramid, a long wire, a statue, whatever. All these very different things still reduce to the same material elements, the same identical population of copper molecules. Science has specific laws for the molecules but no such laws for all the differential spacing and timing factors, the nonmaterial pattern or form factors that are crucial in determining what things are and what laws they obey. These nonmaterial space-time components tend to be thrown out and lost in the reduction process as science aims toward ever more elementary levels of explanation.

Modern molecular biology is quite willing to accept the power of chemical or molecular forces, but when the entities in question are no longer molecules but liv-

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ing organisms, the reasoning suddenly undergoes a flip-flop. The whole reductive materialist philosophy of twentieth-century science is based on this flip-flop error, a failure to adequately credit the nonmaterial elements in reality. This is how science has misled itself and our culture into the excessive emphasis on materialism.

Omni: But how would this concept of modified vitalism alter scientific thinking?

Sperry: Among other things, the theory holds that most of the atoms on our planet are primarily moved around not by atomic or subatomic laws and forces, as quantum physics would have it, but by the laws and forces of classical physics, biology, geology, meteorology, even sociology, politics, and the like. For example, the molecules of higher living things are moved around mostly by the living, vital powers of the particular species in which they're embedded. They're flown through the air, galloped across the plains, swung through the jungle, and propelled through the water not by molecular forces or quantum mechanics but by specific holistic, vital, and also mental properties—aims, wants, needs—possessed by the organisms in question. Once evolved, the higher laws and forces exert downward control over the lower.

Omni: Do you see applications also in physical science?

Sperry: Oh, yes, in the relation of quantum mechanics to classical physics, for example. When physicists found that classical Newtonian laws no longer worked for elementary particles but that a new theory, quantum mechanics, did, they abandoned support for the old Newtonian doctrines in favor of the new quantum theory. The new theory was taken to be a better and more accurate description of nature.

As we see it now, this was a mistake. There's just no way quantum mechanics could replace classical mechanics for things larger than molecules. Quantum theory can't handle the pattern factors that the classical laws naturally incorporate. Neither is wrong. We need both, but for different things.

Omni: Popularized accounts of the new physics imply a less mechanistic and nonmaterialist kind of reality, drawing similarities with Eastern religions. Do you see common features with mentalism?

Sperry: Well, not really. In my thinking, it's not legitimate to extrapolate from the nature of subatomic events to the world at large. The emergent entities at higher levels contain, envelop, and control the properties and expression of the elementary particles. So the common world is better described in the framework of the old classical Newtonian physics, plus biology, geology, and the other sciences. The world is not all dancing energy or "charm" just because the ultimate building blocks seem to be of this strange and elusive nature.

Omni: Aren't you coming back to the initial impressions a nonscientist would probably get under ordinary circumstances?

Sperry: Much of it had seemed a matter of common sense until science came along and began telling us otherwise. Ever since, there's been a growing conflict of culture and world view between scientists and the rest of society, felt most keenly in the humanities and especially in those disciplines most concerned with moral values. Perhaps what I'm saying here, in effect, is an admission: The humanities and common sense were on the right track all along, and we in science were misled.

Omni: Looking back, yours is not the first attempt at a value system based on science. How does your proposal differ from that of Karl Marx or French biochemist Jacques Monod or others?

Sperry: I think they were misled like most of the rest of us were earlier. They accepted science as if this meant embracing the philosophy of materialism and the interpretations of human nature and society that this implies. Marxism upholds values and a world view that are radically opposed to the ones that would emerge from a system based on science as we now understand it. In Marxism, what counts in shaping the world and human affairs are the actions man takes to fulfill his material needs. But this overlooks the key principle of downward causation. Under the mentalist view, the higher idealistic properties that have evolved in man and society can supersede and control and take care of these more primitive needs.

"The higher-order mental processes move their neuronal details much the way different program images on a TV receiver determine the pattern of electron flow on the screen."

The espousal of science by the Marxists, Monod, and many others, including today's secular humanists, has usually meant also the rejection of institutional religion. This, I think, is a mistake, especially with world conditions as they are. We need to raise our sights to higher values above those of self-interest, economic gain, politics, and daily needs for personal subsistence to higher, more long-term, godlike priorities. This isn't something the human brain does naturally or easily. It helps to have the continual reminders, influence, and teaching of people and institutions professionally dedicated to cultivating these higher perspectives.

Omni: But don't you think that a merger with science places excessive restraints on religious doctrines?

Sperry: In the past, under the materialist philosophy, perhaps it would have. Past efforts have been one sided, asking in effect that religion mend its ways to conform with the facts of science, but with no similar request the other way around. On our present terms, it becomes a compromise. Religion gives up dependence on mystical concepts, whereas science gives up much of its traditional materialist legacy.

Omni: If science is to be a greater force in religion, do you think a naturalistic and higher mentalist view of man's creator would leave us enough to believe in and revere?

Sperry: Yes, but this gets into matters that are best left to theology. That's why we need a partnership.

Omni: But would the scientific view leave something that theology could really hope to live with?

Sperry: I think so, on our present terms. Remember that along with the human factors, the scientific view includes the cosmic, the subatomic, and everything in between—the entire evolving web of all creation and the whole matrix of forces involved. No one has yet described anything that even remotely compares in vastness, complexity, diversity, and awesome beauty. It's certainly something to revere!

One can even look at it the other way around—as an overall gain for religion—just as when mankind gave up the belief that the sun was driven across the sky each day by Apollo in his chariot of fire. We now think of the concepts that replaced that as an advance, not a loss.

Omni: But does visualizing God in this way leave anything to satisfy personal emotional needs like loneliness and despair, as faith in a personal deity does?

Sperry: It would depend. There's nothing wrong with personalizing a difficult concept if one realizes what he's doing and doesn't take it literally—especially in the privacy of one's own belief, where it doesn't harm others.

Omni: When you refer to a new world view in science, you include truths, such as insights about human values, that have been contributed by the humanities.

Sperry: Strict separations don't hold anymore. I emphasize science because of its rigorous standards for validation. Also science, like revelation, takes us beyond the bounds of ordinary experience. Science gives deeper insights into the nature and meaning of things. It helps clear the mystery and show the way. It enables us to get a better and more intimate understanding of the forces that made, move, and control the universe and created man.

Omni: Where do you stand then on claims of religion based on revelation?

Sperry: Revelations are fine. We use and welcome them in science. Whenever you become intensely wrapped up in a prob-

lem over a long time, it can become part of you. It gets ingrained in the subconscious so that sudden breakthroughs may almost seem to come from somewhere else. Of course, science throws away many of these revelations when they fail to hold up under experimental test. That's the crux: the double-check against outside reality.

Anyone who has studied the brain—its inputs, outputs, the way it works, and so on—doesn't trust these inner workings without some kind of validation. The human brain can easily go wrong by itself. You can let your internal logical processing run loose and arrive at all kinds of rationalizations. That's the nature of the brain. It has a built-in logical processing system, and it picks up reasons for this and that, but such logic is not always airtight. You can come up with all kinds of wonderful wishful-thinking conclusions, entirely novel concepts made up just of the brain's own runnings. Science gets around this by demanding that the brain process check and double-check with outside reality. That's the difference between science and other sources of belief.

Omni: Your book suggests that an ethic based in science might work for the United Nations and world government.

Sperry: Yes. Much of the difficulty in getting agreement for world government is that peoples of differing faiths and cultures don't want to be governed by the values of opposing ideologies. Capitalist countries don't want to have to submit to Communist values, or vice versa; the same applies to Christians and Muslims, and so on. There seems little chance in the foreseeable future that all the different countries will agree to give up their beliefs to unite under the ethical principles and values of any existing ideology. One can imagine the possibility, however, that all countries might be willing, for purposes of international law, to compromise on a new, relatively neutral ethic founded in the truth and world view of science.

Omni: Is it wise to try to plan and direct a shift in values? Values usually change under the pressure of practical reality, when conditions reach what you've called the "margins of intolerability."

Sperry: Well, you can go this way, letting world conditions force the new values, but by the time this course takes effect, it'll be too late. Availability of basic resources per capita is already going down. The law of diminishing returns is evident everywhere. Species are being eliminated in alarming numbers every year. The dignity and meaning of life for minority creatures around us are almost gone already. The longer you wait for deteriorating conditions to force a value change, the worse the residual quality of our biosphere.

I'd rather go for ideals. I don't like to think only about a sustainable society—how many masses the world could sustain in terms of agribusiness, fisheries, and remaining topsoil if we could get all of our technology working right. I'd much rather calculate what the ideal population would be to make the life experience the best, most beautiful, and wondrous overall.

Omni: It seems many scientists turn their attention to global and philosophical problems as they get older.

Sperry: As most scientists age, they see the end approaching, and they no longer have the patience to waste their time on the kinds of things they thought they could once do forever. You raise your perspectives with age. I don't think this is something to be ridiculed, as many scientists are inclined to do in their younger years. It's something to be fostered and valued—put up rather than put down.

Besides, it's the young people today, thinking young people, who are most concerned about these questions. They're the ones who are most affected and are afraid that in five or ten years we're all going to be dead. When my generation was growing up, this wasn't a concern. We had a future, hope, and heroes. The great cities of the world were still great, and things and people weren't so expendable.

The human brain has tremendous power to become adapted and habituated. Unless you're old enough to have experienced the ambience of earlier times, you don't have much basis for comparison, and you don't sense what has happened. But these days any adult of any age ought to be concerned about global problems. It's just a matter of looking around.

Omni: Does the rational, antimystical approach you advocate leave any room in one's life for realms of the irrational, for fantasy or profound, transcendental mysteries beyond the reach of science?

Sperry: Oh, yes, definitely. I certainly don't think science covers everything, or has all the answers, or dogmatically proclaims a final, absolute, or infallible truth. The more we learn, the more new mysteries we uncover. The argument says nothing against mysticism, fantasy, and the like in art or drama, for example, or in the private sphere or anywhere else where it doesn't influence the laws we're governed by. This is where my concern lies: with those social values and beliefs that directly or indirectly get written into constitutions, manifestos, laws of the land—and perhaps future laws of the planet itself.

We have to remember, too, that strict separations don't hold anymore. The views of science fuse with religion and are on a continuum with the humanities. The two-cultures conflict resolves, and the way is open for the three disciplines to work together. Like everything else today, even the desirable irrationalities of life—the mysteries and the magic—need more rational protection. It's just that with everything considered, it would seem safer for our children's children if we didn't continue to gamble the world's destiny on conflicting mystical answers anymore—or on outmoded materialist ideologies. ∞

"Six weeks at bartender's school at the club's expense, and he still can't make a decent martini!"